

Simultaneous observations of ions of ionospheric origin over the ionosphere and in the plasma sheet at storm-time substorms

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We investigate variations of ion flux over the ionosphere and in the plasma sheet when storm-time substorms are initiated, using simultaneous observations of neutral atoms in the energy range of up to a few keV measured by the low-energy neutral atom (LENA) imager on board the Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) satellite and energetic (9-210 keV/e) ion flux measured by the energetic particle and ion composition (EPIC) instrument on board the Geotail satellite. We examined three storm intervals during which the IMAGE satellite was located near its apogee and the Geotail satellite was in the plasma sheet on the nightside. Low-energy neutral atoms traveling from the direction of the Earth can be created by outflowing ionospheric ions through charge exchange processes. The observed neutral atom flux enhancement at storm-time substorms indicates that substorms can cause an immediate increase of low-energy ion flux over the ionosphere by a factor of 3-10. In the plasma sheet, the flux ratio of O⁺/H⁺ is rapidly enhanced at storm-time substorms and then increased gradually or stayed at a constant level in a timescale of <60 minutes, suggesting a mass-dependent acceleration of ions at local dipolarization and a subsequent additional supply of O⁺ ions to the plasma sheet which have been extracted from the ionosphere at the substorms.